

CHAPTER 6

COMPRESSED AIR SYSTEMS

In the EN3 TRAMAN, we learned about the types of air compressors that an Engineman is required to operate. We also learned how the air is compressed; the requirements and methods of providing oil-free air; how moisture is removed from the air; and some of the safety precautions used when operating or working with compressed air systems.

This chapter contains general information about maintenance and repair of compressed air systems. You should refer to the appropriate manufacturer's technical manuals, maintenance requirements (3-M), and various information books for more specific information. *Naval Ships' Technical Manual*, Chapter 551, "Compressed Air Plants and Systems," is one good source of information.

AIR SYSTEMS

Compressed air is a form of power that has many important uses. An air compressor plant (fig. 6-1) is

required to supply air of adequate volume, quality, and pressure at the various points of applications. This supply of air is measured as pounds per square inch gauge (psig). Air compressor plants or systems are classified as low-pressure (0 to 150 psig), medium-pressure (151 to 1,000 psig), or high-pressure (1,000 psig and above).

Aboard Navy vessels, the A division or repair division is responsible for maintenance and repair of compressed air systems.

LOW-PRESSURE SYSTEMS

Low-pressure (LP) systems provide compressed air up to 150 psig pressure. For branches requiring lower pressures, pressure is usually reduced at reducing stations. The following list contains examples of air pressure requirements for LP air:

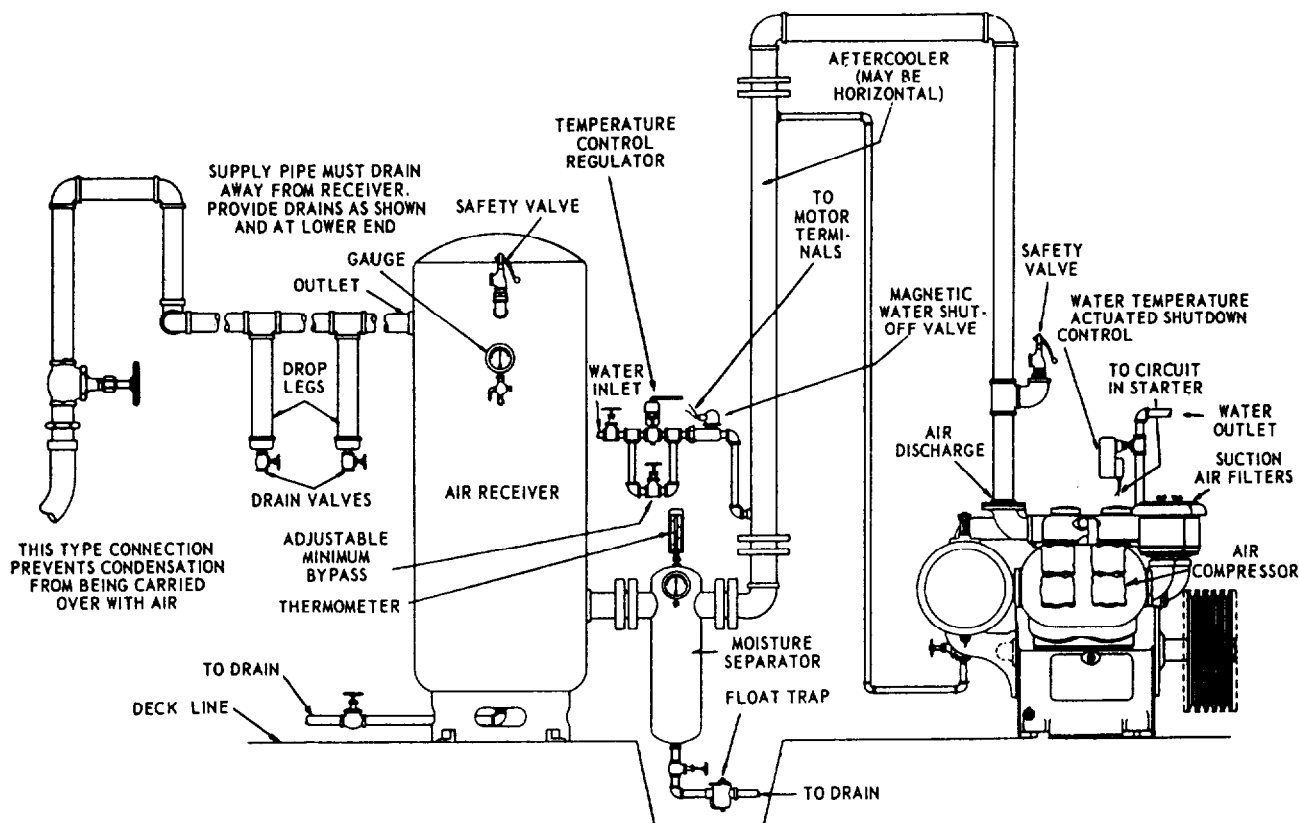


Figure 6-1.—Typical components of a compressed air system.

Laboratories	5 to 50 psig
Shops	60 to 125 psig
Laundries and dry cleaning plants	70 to 100 psig
Hospitals	20 to 50 psig
Ordinary service (tools, painting, and so forth)	60 to 80 psig
Soot blowing for boilers	80 to 125 psig

You will probably be called upon to fix some problem on one of these stations. The three most common problems are wet air, not enough air, or no air at all. First you must trace the system to the station and isolate the problem. It could be just an air valve that is halfway open, a piping leak, a malfunctioning air reducer, an empty air receiver, or an overfilled moisture separator. Figures 6-2, 6-3, and 6-4 are maintenance requirements for LP air compressor systems.

SHIP SYSTEM, SYSTEM, SUBSYSTEM, OR EQUIPMENT			REFERENCE PUBLICATIONS		DATE	
Low-Pressure Air Compressor Level 4 - Equipment Test					August 1990	
Q N R	SYS/COM MRC CONTROL NO	MAINTENANCE REQUIREMENT DESCRIPTION	PERIODICITY CODE	RATES	MAN HOURS	RELATED MAINTENANCE
		Scheduling aids: 1. MRCs Q-1 and R-10W contain blanks to be filled in by ship's force. Data should be available in T/M or certification data sheets. Advise via PMS feedback report if required "fill-in" data is not available to ship's force. 2. "U" MRC (Unscheduled Maintenance Requirement) is provided to assist in restoring system/equipment to an operational condition. Its use may be directed by a scheduled MRC, scheduling aid, or system/equipment failures. 3. Review MRCs Q-3, Q-7R, S-3, S-4, A-1R, A-2R, R-8, and R-9. Omit maintenance requirement(s) if not applicable; no feedback report required. 4. DDEOC ships that have completed a baseline overhaul and entered an extended operating cycle are not to schedule maintenance requirement 72M-1 as a planned requirement. Action is handled automatically by DDEOC program. 5. MRC Q-7R applies to DDG-38, 41, 42, 43, 45, and 46 only. 6. Review MRC Q-1. Omit Maintenance Requirement if EOSS is installed that accomplishes maintenance requirement; no feedback report required. 7. Maintenance requirement R-1 applies to compressors used to supply diver's air only. ‡ Mandatory scheduling required. **For scheduling purposes only; no MRC is provided.				
4	57 X72T N	1. Test low oil pressure shutdown switch.	Q-1	EN/MK2 FN	0.8 0.8	None
	50 B6ET N	1. Obtain and forward lube oil sample for laboratory analysis.	Q-2	EN/MK3	0.2	None
	80 X72U N	1. Clean and inspect spacer cylinder filter; inspect and clean spacer cylinder.	Q-3	EN/MK3	1.0	None
	50 X72W N	1. Clean and inspect compressor air intake filter element.	Q-5	EN/MK3	0.5	None
4	50 X72X N	1. Test compressor drain failure shutdown probe/relay switch.	Q-6	EN/MK2 EM3	0.4 0.4	None
4	80 V52H N	1. Test low-pressure air system. NOTE: Accomplish quarterly in port and when determination of operational readiness of compressor is required.	Q-7R	EN/MK2 FN	2.0 2.0	None
	A8 A9YL N	1. Inspect drive belt(s).	S-1	EN/MK3	0.5	None
	50 X72Y N	1. Clean and inspect compressor fresh water/condensate drain strainers.	S-3	EN/MK3	1.0	A-5R1
	80 X72Z N	1. Clean and inspect compressor unloader air strainer.	S-4	EN/MK3	0.2	None
4	A8 X73A Y	1. Test relief valves. NOTE: Accomplish annually or every 2000 hours of compressor operation.	A-1R	EN/MK3	1.0	None

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SYS/COM MIP CONTROL NUMBER A - 004/115-80

Figure 6-2.—A maintenance index page for low-pressure air compressor systems (page 1 of 3).

TYPE	SYSCOM MRC CONTROL NO.	MAINTENANCE REQUIREMENT DESCRIPTION	PERIODICITY CODE	RATES	MAN HOURS	RELATED MAINTENANCE
Q	A8 B3PU N	1. Inspect compressor unit resilient mounts. NOTE: Accomplish annually and after any rework.	A-2R	EN/MM3	0.2	None
	50 X73G N	1. Treat fresh water cooling system. NOTE: Accomplish annually and when cooling water system has been drained.	A-5R	FN	0.4	None
		1. Submit work request to Intermediate Maintenance Activity (IMA) to recertify air receivers as per NSTH S9086-Sy-STM-010/CM-551.	72M-1 **			
		1. Obtain air sample for analysis NOTE: Accomplish each time the compressor is disassembled or overhauled which can cause possible contamination of air supply for Diver's air. Accomplish by qualified divers only.	R-1 **			
	35 X73B Y	1. Clean and inspect compressor suction and discharge valves. NOTE: Accomplish every 4000 hours of compressor operation.	R-2	EN/MM2 FN	6.0 6.0	None
	44 X73D M	1. Clean and inspect fresh water expansion tank vent breather. NOTE: Accomplish every 2000 hours of compressor operation.	R-8	EN/MM3	1.0	None
	53 X73E M	1. Clean, inspect, and adjust air-flow control valve. NOTE: Accomplish every 4000 hours of compressor operation.	R-9	EN/MM3 FN	1.0 1.0	None
Q	53 X73F M	1. Test operate idle compressor. NOTE: Idle is defined as not having been operated within the past 7 days.	R-10W	EN/MM3 FN	0.5 0.5	None
	57 X73H Y	1. Renew compressor oil filter and lube oil; clean breather.	U-2			None
INACTIVE EQUIPMENT MAINTENANCE						
		The following requirements will be scheduled when equipment is inactivated for periods of prolonged idleness.				
		Lay-Up Maintenance				
	42 W17J N	1. Install protective cover on air filter/silencer. NOTE: Cover must be installed before exposure to industrial hazards.	LU-1	FN	0.2	None
		Periodic Maintenance				
	10 B5VB N	1. Turn idle compressor by hand. NOTE: Accomplish every 7 days during inactive period.	PM-1	EN/MM3	0.2	None
		Start-Up Maintenance				
	A8 B3PT N	1. Remove protective cover from air filter/silencer. NOTE: Accomplish before starting compressor.	SU-1	FN	0.1	None
		1. Obtain and forward lube oil sample for laboratory analysis. NOTE: Use MRC Q-2.				

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1-790/85 (REV. 2-82)

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Figure 6-3.—A maintenance index page for low-pressure air compressor systems (page 2 of 3).

MEDIUM-PRESSURE SYSTEMS

Medium-pressure systems provide compressed air within the range of 151 to 1,000 psig pressure. These systems are not extensive and are generally provided with individual compressors located near the loads. Medium-pressure systems are mainly used for the starting of diesel engines, soot blowing of boilers and

high-temperature water (HTW) generators, and hydraulic lifts.

Some Navy vessels do not have a separate air compressor to supply a direct medium-air pressure. Instead, compressed air from HP air systems is stored in the user's air flasks (banks) at high pressure. Then when needed, the air is routed through a pressure-reducing

TYPE	SYSCOM MRC CONTROL NO.	MAINTENANCE REQUIREMENT DESCRIPTION	PERIODICITY CODE	RATES	MAN HOURS	RELATED MAINTENANCE
		<p>Operational Test</p> <p>1. Test operate idle compressor.</p> <p>NOTE: Use MRC R-10W.</p> <p>DISTRIBUTION STATEMENT D: DISTRIBUTION AUTHORIZED TO DOD COMPONENTS AND DOD CONTRACTORS ONLY; CRITICAL TECHNOLOGY; AUGUST 1990; OTHER REQUESTS SHALL BE REFERRED TO THE NAVAL SEA SYSTEMS COMMAND (SEA 04TD). DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THE DOCUMENT.</p>				

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Figure 6-4.—A maintenance Index page for low-pressure air compressor systems (page 3 of 3).

manifold. In this case, medium-air pressure maintenance requirements are coupled with the HP air system's PMS. Troubles and repairs to medium-pressure systems are the same as the LP and HP air systems. Those medium-pressure air systems equipped with air compressors should have a separate preventive maintenance schedule.

HIGH-PRESSURE SYSTEMS

These systems provide compressed air within the range of 1,000 to 6,000 psig pressure. Hazards that increase with higher pressures and capacities can be minimized by using separate compressors for each required pressure. Systems operating at 3,000 psig may

require small amounts of air at lower pressures, which is supplied through pressure-reducing stations.

Always use caution with HP systems! When HP air enters suddenly into pockets or dead ends, the air temperature in the confined space increases dramatically. If there is any combustible material in the space and the air temperature increases to the ignition point of the material, an explosion may occur. Explosions of this type may set up shock waves that travel through the compressed air system. This travel may cause explosions at remote points. Even a small amount of oil residue or a small cotton thread may be sufficient to cause ignition.

Some common pressure requirements for HP systems may be as follows:

Torpedo workshop	600 to 3,000 psig
Ammunition depot	100, 750, 1,500, 2,000, and 4,500 psig
Wind tunnels	Over 3,000 psig
Testing laboratories	Up to 6,000 psig

Figures 6-5 and 6-6 show a maintenance index page (MIP) for one design and make of an HP air compressor system. This will give you an idea of the differences in planned maintenance requirements between the LP air (see figs. 6-2, 6-3, and 6-4 for comparison) and HP air systems. It is very important that the PMS you are using are the correct ones.

You should inspect air flasks, receivers, separators, and piping for damage or external corrosion once every 6 months. Enter the inspection date and results in the Maintenance and Material Management (3-M) Systems by submitting a work request for any discrepancies found. You must document completion of all inspection results through PMS.

AIR DRYERS OR DEHYDRATORS

The Navy uses three types of air dehydrators for drying LP air. These are the refrigeration (type I), desiccant (type II), and combination of both refrigeration and desiccant (type III). HP air application uses only the type III. The Navy is replacing the various types of desiccant used in the fleet with activated alumina beads in 1/8-inch diameter spheres. This type of desiccant is also intended to reduce dust problems produced by the other various types. The dust causes clogged filters and other component malfunctions.

MAINTENANCE OF LP AND HP AIR DEHYDRATORS

Follow the scheduled maintenance of LP or HP air dehydrators according to the PMS requirements. The following is a sample LP air dehydrator maintenance schedule and is for general information only:

1. Daily:

- Check applicable power on lights, flowmeter readings, cooling water temperatures, heater temperatures, and outlet air temperatures for proper operation.
- Note any dehydrator filter element pressure drops for element replacement.
- Periodically blow down and clean the condenser water strainer.
- Blow down type I and type III dehydrators. Dump the valve if more than 1/2 pint of water drains out; the automatic feature is not working.
- Check the purge pressure and the free movement of the purge flowmeter float of type II and type III dehydrators.

2. Weekly: Blow down the inlet separator, prefilter, and trap dump valve of dehydrators by opening the manual drain valve.

3. Monthly:

- Check the outlet air moisture content. The dew point should be below -40°F at 80 lb/in^2 for both type II and type III dehydrators, and below 40°F at 80 lb/in^2 for type I dehydrators. An excessive dew point indicates a malfunction.
- Check the inlet and outlet filters and the purge filter for the type II and type III dehydrators. Replace the filter elements if necessary.

4. Quarterly:

- Clean the condenser water tubes.
- Disassemble and clean the inlet and interstage separators and purge the solenoid valves.

5. Annually:

- Remove and calibrate the pressure gauges. Adjust them to give maximum error 2 lb/in^2 (1 percent of full scale).
- Disassemble the desiccant chambers. Clean the assembly of dust, oil, and dirt. Replace the desiccant

SHIP SYSTEM, SUBSYSTEM OR EQUIPMENT			REFERENCE PUBLICATIONS		DATE		
High-Pressure Air Compressor Level 4 - Equipment Test					May 1990		
T S E	Q W E R	SYS/COM MRC CONTROL NO.	MAINTENANCE REQUIREMENT DESCRIPTION	PERIO DICITY CODE	RATES	MAN HOURS	RELATED MAINT ENANCE
			Scheduling aids: 1. MRC A-1 contains blank spaces to be filled in by ship's force before implementation. Until these "fill-in" data elements are applied, maintenance requirement cannot be effectively accomplished. Advise via PMS feedback report if required "fill in" data is not available to ship's force. 2. "U" MRC (Unscheduled Maintenance Requirement) is provided to assist in restoring system/equipment to an operational condition. Its use may be directed by a scheduled MRC, scheduling aid, or system/equipment failures. 3. Maintenance requirement R-4 applies to compressors used to supply diver's air only. 4. MRC A-5R applies if MACHALT 551-44012 (ECP 254) has been accomplished. **For scheduling purposes only; no MRC is provided.				
		A8 Y57D Y	1. Clean and inspect zincs.	Q-1	EN/MM3	0.5	None
		59 A7WE N	1. Test low oil pressure shutdown switch. 2. Test low air pressure switch.	Q-2	EN/MM3	0.5	None
		50 B6EF N	1. Obtain and forward lube oil sample for laboratory analysis.	Q-3	EN/MM3	0.2	None
		50 B6EG N	1. Inspect HPAC and dehydrator piping for air leaks.	Q-10	EN/MM3	1.0	None
4		45 V16T N	1. Test compressor air relief valves.	A-1	EN/MM3	2.0	None
		A7 B1XF N	1. Inspect resilient mounts. NOTE: Accomplish annually and after any rework.	A-5R	FN	0.3	None
		50 B2YE N	1. Treat fresh water cooling system. NOTE: Accomplish annually and when cooling system has been drained.	A-10R	FN	1.0	None
			1. Inspect air flasks recertification record to determine recertification due dates. If due, submit work request to Intermediate Maintenance Activity (IMA) to recertify air flasks as per NSTM S9086-SY-STM-010/CH-551.	36M-1 **			
4		A8 Q56E N	1. Test operate compressor. NOTE: Accomplish when determination of compressor operational readiness is required.	R-1	EN/MM3	0.4	None
		44 Q56F N	1. Clean air intake filter. NOTE: Accomplish every 500 hours of compressor operation.	R-2	EN/MM3	0.5	None
			1. Obtain air sample for analysis NOTE: Accomplish each time the compressor is disassembled or overhauled which can cause possible contamination of air supply for diver's air. Accomplish by qualified divers only.	R-4 **			

Figure 6-5.—A maintenance Index page (MIP) for one design and make of high-pressure air compressor systems (page 1 of 2).

if it is significantly powdered, burned, or discolored with oil carry-over.

- Remove the desiccant chamber check valves. Discard and replace them with new items. Adjustment and repair of the dehydrators and their components should be accomplished according to the appropriate equipment technical manuals.

AIR QUALITY TESTING

Air quality testing is the daily monitoring of the dry air dew point at the dehydrator's outlet. Testing is conducted with a LP frost point indicator, MIL-I-24144.

MAINT INDEX	SYSCOM MRC CONTROL NO	MAINTENANCE REQUIREMENT DESCRIPTION	PERIO DICITY CODE	RATES	MAN HOURS	RELATED MAINT ENANCE
	44 Q56H N	1. Renew automatic drain valve gear reducer lube oil. NOTE: Accomplish every 2000 hours of compressor operation.	R-12	EM/MM3	0.3	None
	44 Q56J Y	1. Renew compressor lube oil and filter; clean breather.	U-1			None
		INACTIVE EQUIPMENT MAINTENANCE				
		The following requirements will be scheduled when equipment is inactivated for periods of prolonged idleness. Lay-Up Maintenance 45 W67G N 1. Flush sea water side of cooling system. 63 X83M N 1. Install protective cover on air filter/silencer. NOTE: Cover must be installed if equipment is to be subjected to industrial hazards. Periodic Maintenance 50 B6EH N 1. Turn idle compressor shaft by hand. NOTE: Accomplish every 7 days during inactive period. Start-Up Maintenance B3 Y25S N 1. Remove protective cover from air filter/ silencer. NOTE: Accomplish before starting compressor 1. Obtain and forward lube oil sample for laboratory analysis. NOTE: Use MRC Q-3. Operational Test 1. Test operate compressor. NOTE: Use MRC R-1. DISTRIBUTION STATEMENT D: DISTRIBUTION AUTHORIZED TO DOD COMPONENTS AND DOD CONTRACTORS ONLY; CRITICAL TECHNOLOGY; MAY 1990; OTHER REQUESTS SHALL BE REFERRED TO THE NAVAL SEA SYSTEMS COMMAND (CEL-TD). DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THE DOCUMENT.				
			LU-1	EN/MM3 FN	0.5 0.5	None
			LU-2	FN	0.2	None
			PM-1	EN/MM3	0.2	None
			SU-1	FN	0.1	None

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SYSCOM MIP CONTROL NUMBER A - 003/096-50

Figure 6-6.—A maintenance index page (MIP) for one design and make of high-pressure air compressor systems (page 2 of 2).

DEHYDRATOR DEW POINT READINGS

This reading is taken every 4 hours of dehydrator service. Readings verify that the dehydrator is operating correctly. The normal readings of the various types of air dehydrators are as follows:

1. LP air (type I) dehydrator's normal dew point reading is a dew point temperature reading of 40°F or lower at 80 lb/in². This indicates that the dehydrator is delivering an air quality within its design capability. A reading of 50°F or higher at 80 lb/in² indicates that the dehydrator is not working properly, and you should check the applicable technical manual.

2. A dew point temperature reading of -40°F or lower at 80 lb/in² is normal for LP (type II and type III) dehydrators. A reading of -20°F or higher at 80 lb/in indicates that the dehydrator is not operating properly, and you should check the applicable technical manual to correct the problem.

3. For HP air dehydrators, a dew point temperature reading of -60°F or lower at atmospheric pressure is normal. A reading higher than -60°F at atmospheric pressure indicates that the dehydrator is not working properly, and you should check the technical manual for the solution to the problem.

MAINTENANCE OF RECIPROCATING AIR COMPRESSORS

To keep the ship's air compressors operating efficiently at all times, you must know what common troubles may occur and their causes. You must know how to care for the air intakes; how to maintain and replace air valves; how to take care of air cylinders and pistons; and how to adjust bearings, wrist pins, and couplings. You must be able to maintain, troubleshoot, and repair the lubrication, cooling, control, and air systems.

AIR INTAKES

A supply of clean, cool, dry air is essential to the satisfactory operation of compressors. To ensure this, the *air intake filters* must be regularly inspected and cleaned; otherwise, the filter becomes clogged and causes loss of capacity. A clogged air intake screen or filter may also cause a compressor to draw oil from its own crankcase, around rings, or through oil seals, resulting in an explosion.

Remove the filter element and clean it with a jet of hot water or steam, or plunge it into a strong solution of sal soda. The filter body should be drained and replaced. If the filter is the oil-wetted type, dip it in clean, medium-grade oil and allow it to drain thoroughly before replacing the filter in the intake. **Do not use gasoline or kerosene for cleaning filters!** The fumes may collect and explode in the compressor or receiver.

Take care to prevent entrance of rain or spray into *intake pipes*, and provide a means for draining the intake pipe of any water that may collect. The lines should be as short and direct as possible.

For air compressors used to supply air for the divers, you must prevent the compressor from taking in exhaust gases coming from any internal combustion engines.

You must also prevent any possible intake of fumes coming from fuel tank vents, spilled oil, or gasoline.

AIR VALVES

Air inlet and discharge valves must be kept clean and in good working order. Leaky valves are generally dirty valves, and they cause capacity loss. The valves are removed by first loosening their setscrews or clamps, and then removing their cover plates. Each valve and valve unloader, if fitted, may then be lifted out. Each valve should be marked to make certain that it is returned to the same port from which it was removed.

Valves removed for inspection should not be taken apart for cleaning unless their conditions make it necessary. Dirt or carbon in valve ports can usually be removed without taking the valve apart. This is done by soaking the valves in kerosene, and then giving them a stiff brushing or a light scraping. Valve action should be tested by inserting a screwdriver through the seat ports; the valve should lift and close freely.

If it becomes necessary to disassemble the valve, note the arrangement of the various parts so that the proper relationship will be kept when the valve is reassembled. (Periodic shipboard reports indicate damage to pistons and associated valve parts frequently results from improperly assembled valves that protrude in the way of the oncoming piston.)

Before replacing air valves in a cylinder, inspect the gaskets and replace any that are damaged. Copper-covered asbestos or plain, thin copper gaskets should be used. If these are not available, 1/16-inch compressed-asbestos sheet gaskets may be used temporarily. Each valve assembly should be inserted in the same hole from which it was removed. Since it may be difficult, in many cases, to distinguish between suction or discharge valves, extreme care must be taken when the valves are being inserted in the cylinder. Make certain that suction valves open TOWARD, and the discharge valves AWAY FROM, the center of the cylinder; otherwise, serious damage or loss of capacity will result. Then place the valve cover on the cylinder, making certain that its gasket is squarely in place; draw down on the cover nuts evenly, and in turn, so as not to tilt the cover. Tighten down the valve setscrew or clamping bolt, drawing it tight to hold the valve on its seat. If special locknuts are not provided to seal against leakage at the threads of the valve setscrew, a turn of solder or fuse wire should be placed around the screw and set down into a recess by a locking nut.

CYLINDERS AND PISTONS

The cylinders on pistons should be inspected only AFTER the manufacturer's technical manual has been consulted. Be careful when removing heads, particularly where metal-to-metal joints are involved, to prevent damage to the joint.

If replacement of piston rings is required because they are worn or broken, take accurate measurements of the cylinder liners. Standard size rings may be used in oversize cylinders if the oversize does not exceed 0.003 inch per inch of cylinder diameter. The liner may also need to be replaced if it is badly worn or out of round. When replacing piston rings, first fit them to the cylinder to check for proper end clearance. You can file the ends, if necessary, to make them fit. The side clearance of the rings should be such that the rings will fall easily into the piston grooves, which should be deep enough for the ring thickness. Ring splits should be staggered. After you assemble the piston, wire the rings tight with a soft copper wire so that they will enter the bore easily. This wire can be removed through the valve ports after the ring has started into the cylinder bore.

When reassembling the air cylinders and heads, be sure they are all drawn down evenly, especially on multistage compressors where the heads contain cylinders for third and fourth stages. Otherwise, the result will be excess wear on the cylinders and pistons.

When a compressor piston has been replaced, the piston end clearance must be checked. This is done by inserting a lead wire through a valve port or indicator connection. Jack the compressor over. When the piston has moved to the end of its stroke, the lead will be flattened to the exact amount of clearance. The wire should be long enough to permit a reading near the center of the piston. These readings should be taken after any adjustment or replacement of the main, crank pin, wrist pin, or crosshead bearings. Methods of adjusting the clearances vary according to the compressor design. You should consult the manufacturer's instructions for suggested adjustment.

MISCELLANEOUS ADJUSTMENTS

From time to time other miscellaneous adjustments are required on compressors, including those pertaining to wrist pins, crosshead shoes, reduction gears, couplings, and V-belt drives. The manufacturer's technical manual will give you specific information for the care, adjustment, and replacement of all fitted bearings. Refer to the manufacturer's instructions for

detailed information on when and how to make these adjustments.

Wrist pin bushings are replaced when necessary. This is done when they are worn to the point of becoming noisy. In making a replacement, be sure the oil hole in the bushing is properly lined up with the oil hole in the connecting rod. After being pressed into the rod, the new bushing must be reamed.

Crosshead shoes are provided with shim or wedge adjustment. Wear should be slight, but adjustment should be made when the travel of the piston rod causes a movement in the stuffing boxes.

Alignment of reduction gears and pinions should be checked periodically, especially on a new compressor. Misalignment may be caused later by settling, straining, or springing of foundations; pipe strains on turbine-driven compressors; bearing wear; or springing due to heat from a turbine.

Flexible couplings require very little maintenance when they are properly lined up. Some types require occasional lubrication to prevent excessive wear of springs and bushings. A noisy coupling is an indication that the bushing is worn and requires replacement.

V-belt drives require adjustment for belt tension. Belts generally stretch slightly during the first few months of use. A loose belt will slip on the motor pulley and cause undue heating and wear on the belt. A tight belt will overload the bearings. Belts should be protected against oil and high temperatures. To prevent rapid deterioration, belts should not be used at temperatures above 130°F. V-belts are usually installed in sets of two or three. If a single belt is worn or deteriorated, the complete set should be replaced to ensure that each belt will carry its share of the load.

LUBRICATION SYSTEM

Proper care of a compressor lubrication system includes the following:

- Keep the oil at a normal level in the reservoir at all times to maintain proper oil temperature.
- Change crankcase oil periodically, and at the same time clean and flush the crankcase and clean the oil filter.
- Maintain proper lube-oil pressure by keeping the oil pump in good working order and adjusting the bypass relief valve.

- Keep the oil cooler free from leaks (since pressure on the water side exceeds that of the oil) to prevent oil contamination and emulsification.

- Properly adjust the lubricator for the specified quantity of oil feed.

COOLING SYSTEM

Proper care of a compressor cooling system includes the following inspections and maintenance procedures:

- Periodically inspect the intercoolers and aftercoolers.

- Remove collections of gummy oils or tarry substances from the cooler tubes by washing tube nests with a suitable solvent and drying them thoroughly before reassembling.

- Correct any leakage in tube nests to prevent leaks of water into the compressor while secured or leaks of air into the water side during operation.

- Inspect and clean the cylinder water jackets periodically with a cleaning nozzle.

When filling the cooling water system after the compressor has been drained, open the water inlet slightly to allow the water to rise slowly in the cooler shells and water jackets. Vent valves fitted to the water spaces should be opened to permit entrapped air to escape and to remove any air pockets.

CONTROL DEVICES

Because of the great variety of regulating and unloading devices used on compressors, you will have

to consult the manufacturer's technical manual for information regarding the adjustment of these devices on particular compressors.

If a control valve fails to work properly, it should be taken apart and cleaned. Some valves are fitted with a filter filled with a sponge or woolen yarn to prevent particles of dust or grit from being carried into the valve chamber. These filters remove gummy deposits from the oil used in the compressor cylinders. When repacking, use only genuine wool. Cotton will pack and stop the airflow. Relief valves are very important for safe compressor operation. They should be set as specified by the manufacturer and lift-tested by hand each time the compressor is placed in operation. To check the setting periodically, test by raising the pressure in the spaces to which they are attached.

SUMMARY

Since an Engineman may encounter so many types of compressed air systems, air dryers, and air compressors both ashore and aboard Navy vessels, this chapter presented only general procedures and facts. To maintain, repair, and overhaul specific compressed air systems, air dryers, or reciprocating air compressors, you must refer to the manufacturer's technical manuals. A definite preventive maintenance schedule with frequency and assignment of responsibility is required. You should have the manufacturer's manual handy to establish minimum requirements and to follow its recommendations for maintenance.